

Optimization of Left-Turn Traffic Signals

- ✓ Protected/ Permitted phasing is the preferred option for most locations.
- ✓ Sites with one, two, or three opposing lanes, warrant the queue detector at the third, fourth, and fifth vehicles respectively.
- ✓ Safety requirements warrant a Protected phase for sites with unacceptable sight distance, speeds greater than 45mph, more than three opposing lanes, or a history of left-turn crashes.
- ✓ The attached flow chart can be used by traffic engineers as a guide to select phasing type and queue detector locations.

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The use of detection to activate protected left-turn phasing has developed primarily through empirical trial and error and has been instituted without the supporting scientific theory. A study was conducted by the Utah Traffic Lab of the University of Utah for the Utah Department of Transportation that compares the performance of left-turn phasing to provide quantifiable benefits of one phasing over another. Permitted, protected, and protected/permitted (P/P) phasing were analyzed for a range of left-turn volumes and opposing through traffic in order to develop rational curves. The measure of left, through and overall intersection delay was used to compare the different phasing performances. Specific consideration was given to determining the optimal location of the queue detector for P/P phasing. From the analysis, guidelines have been developed for determining the type of left-turn phasing based on left-turn volume, opposing through volume, and lane geometry.

The analysis indicates that P/P phasing provides the best method of left-turn phasing signal control under most conditions. The P/P phasing allows for a wide range of control and is better able to accommodate the changing volumes throughout the day. The optimal queue detector location for P/P varies, based on opposing volume and geometry. UDOT typically has placed the queue detector location at the third vehicle. This is placed on permitted phasing to accommodate two "sneakers" per cycle. Therefore, the third vehicle location triggers the protected phasing so that all left-turning vehicles can be accommodated. However, this assumes that no gaps exist in the oncoming traffic to provide capacity for left turns and that the opposing traffic is operating near capacity. Based on this assumption, delay comparisons indicate that geometry and queue locations are related. For a single-lane geometry, the third vehicle location is appropriate. However, as the geometry is increased to two or three lanes, the opposing through volume increases and the overall intersection delay is reduced when the detector location is moved to the fourth vehicle location.

The complete research report is available upon request from UDOT Research Division. For more details of the study, go to www.trafficlab.utah.edu.

Flowchart Of Left-Turn Phasing Guidelines

